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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/761,240	01/17/2001	Josef-Georg Bauer	GR 98 P 2124 P	5138
24131	7590	02/13/2006	EXAMINER	
LERNER GREENBERG STEMER LLP			MONDT, JOHANNES P	
P O BOX 2480			ART UNIT	
HOLLYWOOD, FL 33022-2480			PAPER NUMBER	
			3663	

DATE MAILED: 02/13/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	<b>Application No.</b> 09/761,240	<b>Applicant(s)</b> BAUER ET AL.	
	<b>Examiner</b> Johannes P. Mondt	<b>Art Unit</b> 3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 09 December 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 5 and 6 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 5-6 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/09/05 has been entered.

### ***Response to Amendment***

Amendment filed 12/09/05 with said RCE forms the basis of this office action. In said Amendment Applicant cancelled claims 1-4 and added new claims 5 and 6. Comments on Remarks submitted with said Amendment are included below under "Response to Arguments".

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

1. **Claim 6** is rejected under 35 U.S.C. 103(a) as being unpatentable over Bauer et al (5,668,385) in view of Gerstenmaier et al (DE 39177769 A1).

*Bauer et al* teach a power semiconductor element comprising:

an emitter region 6/8 (cf. col. 5, l. 64 – col. 6, l. 3);

a stop zone 7 (cf. abstract and col. 4, l. 59-61) in front of said emitter region;  
said emitter region and said stop zone having mutually opposite conductivities (p-type emitter, n-type stop zone: see col. 4, l. 56-61); and said stop zone having foreign atoms by virtue of being doped with an n-type conductivity doping substance (col. 4, l. 50-61).

*F. Bauer et al* do not teach the further limitation that said atoms of said doping substance have at least one energy level within the band gap of the semiconductor and at least 200 meV away from both a conduction band and a valence band of the semiconductor wherein a number of effective doping atoms generated in the stop zone changes in dependence on whether the power semiconductor element is in a blocking operation or in a conducting operation, and that said foreign atoms comprise selenium atoms.

*However, it would have been obvious to include said further limitation in view of Gerstenmaier et al*, who, in a published patent application on a thyristor (cf. title; hence closely related to the GTO (Gate-Turn-Off) thyristor-relevant art by F. Bauer et al; see F. Bauer, abstract), teach that in n-type recesses 11 (cf. col. 2, l. 4) between p-emitter portions 4 (cf. col. 1, l. 53-57) on the anode (A) side (cf. Figure 1) the dopant should be selected so as to have an ionization energy level within the band gap of the semiconductor and at least 300 meV away, a fortiori at least 200 meV away, from both a conduction band and a valence band of the semiconductor (cf. col. 2, l. 49 – col. 3, l. 17), *for the specifically stated purpose* to reduce the temperature dependence of the threshold current (cf. abstract and col. 2, l. 30 – col. 3, l. 17) through an increase in

the slope of the conductivity versus temperature. The strong dependence on temperature of the occupancy level of the conduction band (cf. col. 3, l. 2-6) inherently implies the number of effective doping atoms generated in the stop zone, i.e., the number of atoms having contributed a charge carrier to the conduction band, to change in dependence on whether the power semiconductor element is in a blocking operation (no ohmic heating) or in a conducting operation (ohmic heating), because in the conducting state the temperature is higher relative to the blocking state in view of the ohmic heating associated with any current flow in a resistive medium. In particular, Gerstenmaier et al advocate the selection of selenium atoms as said foreign atoms (see their claim 7)

*Motivation* to include the teaching by Gerstenmaier in this regard in the invention by F. Bauer et al derives from the resulting constancy, hence increased reliability, of the threshold voltage as well as the broadening of the temperature range towards higher temperatures within which the maximal blocking voltage of the thyristors can be secured (cf. col. 1, l.27-37).

*Combination* of the teaching by Gerstenmaier et al with the invention by F. Bauer is easily achieved by selecting the dopant according to the criterion by Gerstenmaier on ionization energy levels in relation to the semiconductor band gap (Gerstenmaier lists a few examples, such as Molybdenum, Germanium, Cesium, Barium, Selenium and Niobium; for additional possibilities see S.M. Sze, "Physics of Semiconductor Devices", page 21, in which a list is provided including the case specifically cited by Gerstenmaier et al when the semiconductor is silicon (cf. col. 3, l. 13)). The practical implementation of

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the combination only involves selecting the dopant for the recesses between p-emitter regions 8 within stop layer 7 (cf. Figure 1b). Success of the implementation of said combination can therefore be reasonably expected.

1. **Claim 5** is rejected under 35 U.S.C. 103(a) as being unpatentable over F. Bauer et al in view of Tohyama (5,684,323) and Gerstenmaier et al DE 39177769 A1).

*Bauer et al* teach a power semiconductor element comprising:

an emitter region 6/8 (cf. col. 5, l. 64 – col. 6, l. 3);  
a stop zone 7 (cf. abstract and col. 4, l. 59-61) in front of said emitter region;  
said emitter region and said stop zone having mutually opposite conductivities (p-type emitter, n-type stop zone: see col. 4, l. 56-61); and said stop zone having foreign atoms by virtue of being doped with an n-type conductivity doping substance (col. 4, l. 50-61).

*F. Bauer et al* do not teach the further limitations that said atoms of said doping substance comprise sulfur atoms.

*Although F. Bauer et al* do not necessarily teach the further limitation that the selection of said foreign atoms is to include sulfur (S), it would have been obvious to include said further limitation because sulfur (S) has long been applied as a dopant in silicon for its deep ionization level so as to tailor the current-voltage characteristics of said silicon, as witnessed by Tohyama (cf. col. 6, l. 66 – col. 7, l. 11). In this regard it is noted that the doping in Tohyama and Gerstenmaier et al serve the same purpose in that the resulting temperature dependence of the occupancy levels of the conduction band inherently leads to a desired change in the current-voltage characteristic due to

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ohmic heating. Applicant is reminded that sulfur (S) is known to meet the physical criterion stated by Gerstenmaier et al for the selection of said atoms, as evidenced by the scientific data on donor and acceptor ionization energies of sulfur (S) in silicon (see e.g., S.M. Sze, "Physics of Semiconductor Devices", Figure 13, page 21, previously made of record (5/15/2002)): from said list it is evident that sulfur satisfies the aforementioned physical criterion. It is thus evident from Tohyama that *combination of* the teaching by Tohyama of the inclusion of sulfur as the deep ionization energy dopant only requires standard doping techniques and may be *motivated by* specific design considerations on the desired current-voltage characteristics, determined as the latter are by the depth of the energy levels.

Finally, Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416.

### ***Response to Arguments***

Applicant's arguments filed 12/09/05 have been fully considered but they are not persuasive. In particular, Applicant's argument in support of patentability of the present claims 5 and 6 appears to depend on lack of motivation to include the teaching by Gerstenmaier et al in the invention by Bauer et al. However, as has been pointed out before, what has to be learned from Gerstenmaier is merely the method of reduction of the temperature dependence of the threshold current. Examiner asserts once more that this is an obvious advantage for anyone in the art of thyristors as a whole, including the

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specifically the Gate Turn-off Thyristor (GTO) by Bauer et al: if thyristor threshold currents are substantially influence by the temperature then their threshold current would depend inadmissibly on whether they had been used just prior to once reaching a higher voltage state. Therefore, the invention as claimed is once again rejected over the same art as in the previous detailed office action on the merits.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

JPM  
February 4, 2006

Patent Examiner:

  
Johannes Mondt (Art Unit: 3663)